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RESEARCH ARTICLE

Health status deterioration in field-protective forest belts in northeastern Bulgaria

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Abstract

A system of field-protective forest belts was created in the 1950-60s in northeastern Bulgaria to maintain soil moisture, reduce wind speed and protect soil against wind erosion, improve the microclimate, and increase the fertility of agricultural lands. The deciduous tree species such as *Fraxinus excelsior*, *F. angustifolia*, *F. americana*, *Gleditsia triacanthos, Quercus robur*, *Q. cerris*, *Q. rubra*, *Robinia pseudoacac*ia, *Ulmus minor* etc., were in common use for afforestation. Since 2020, the processes of deterioration, premature leaf fall and drying of ash trees have been observed. The deterioration affected *Fraxinus excelsior* and *F. angustifolia* on more than 200 ha, mainly on the territory of the State Hunting Enterprise Balchik, State Forest Enterprises Dobrich and General Toshevo. The results from the health status assessment carried-out in 2023 showed severely damaged ash forest belts with defoliation reaching up to 80-100% of tree crowns. Browning of leaves and petioles, and wilting of young shoots, were noticeable. Damage on shoots and stems of ash trees was caused by the insect pests *Cicada orni*, *Cossus cossus*, *Zeuzera pyrina*, *Hylesinus fraxini*, *H. crenatus*, and on leaves – by leaf-damaging and gall-forming fly *Dasineura acrophila* and *D. fraxini*. The complex of fungal species *Armillaria mellea*, *Coriolopsis gallica, Cytospora pulchelia, Daldinia concentrica, Diplodia* sp., *Helicobasidium purpureum*, *Hysterographium fraxini*, were identified on ash trees. Most of them are considered opportunistic pathogens that cause disease on trees under stress conditions. Deterioration of the health status of other major tree species was also observed. The most dangerous insect pest in oak forests – *Lymantria dispar* caused the defoliation of *Quercus cerris* belts. The endophytic fungal pathogen *Biscogniauxia mediterranea* was identified as a causal agent of charcoal disease on *Q. rubra* trees. Dutch elm disease caused by the fungus *Ophiostoma novo-ulmi* resulted in the wilting and death of 80-100% of *Ulmus minor* trees.

Keywords
Field-protective forest belts, health status, biotic agents, northeastern Bulgaria

Introduction

At present, more than 10600 ha have been covered by field-protective forest belts in the northeast of Bulgaria. The establishment of the system of the field protective forest belts resulted in extraordinary environmental benefits, such as: wind protection, reducing evapotranspiration, increasing air humidity, reducing daily temperature amplitudes in the lower air layers, increasing soil humidity and crop yields, overall improvement of soil fertility protection, etc. (Georgiev, 1960; Marinov, 2003; Ristic et al., 2021). Different deciduous tree species were used for afforestation in the system of the field-protective forest belts: *Acer pseudoplatanus* L., *Cedrus* sp., *Gleditsia triacanthos* L., *Fraxinus excelsior* L., *F. angustifolia* Vahl, *F. americana* L., *Robinia pseudoacacia* L., *Quercus robur* L., *Q. cerris* L., *Q. rubra* L., *Tilia platyphyllos* Scop., *Ulmus minor* Mill., etc.

The health status of the field-protective forest belts in the region of northeastern Bulgaria has been a subject of extensive research since their creation in the 1950s. In the past, ice and snow damage was frequently assessed in the youngest forest belts (Zlatanov, 1953; 1957; Dimitrov, Zlatanov, 1956). In the period 1950-70s economically important insect pests were established in the forest belts: *Lytta vesicatoria* (L.) (Zlatanov, 1957; 1970), *Phylloxera quercina* (Ferrari) (Zlatanov, 1960; 1963; 1964), *Phalera bucephala* (L.) (Zlatanov, 1959; 1970), *Lymantria dispar* (L.), *Euproctis chrysorrhoea* (L.), *Tortrix viridana* L., *Operophtera brumata* (L.), *Yponomeuta malinellus* (Zeller), *Xanthogaleruca luteola* (Müller) (Zlatanov, 1962; 1970). Important bioecological regularities were applied to control the most important insect pests (Zlatanov, 1958; 1966; 1970; Georgiev et al., 2021).

Rosnev, Petkov (1994) noted that until the 1980s the ash trees planted in plantations in northeast Bulgaria were in good condition. In the 1990s, a process of health status deterioration began. Diseases caused by necrotrophic fungal pathogens *Cytospora pulchelia* (Sacc.), *Daldinia* sp. appeared on ash stems in a decade of drought.

Since 2020, a process of dieback, premature leaf fall and drying of ash trees was observed in the field-protective forest belts at the territory of State Hunting Enterprise (SHE) Balchik, and State Forest Enterprises (SFEs) General Toshevo and Dobrich (Mateva, Kirilova, 2021; 2022; Dodev et al., 2023). Deterioration of the health status mainly affected the common ash (*F. excelsior*) and the narrowed-leaved ash (*F. angustifolia*) trees on more than 200 ha, mainly on the territory of the SHE Balchik and SFEs General Toshevo and Dobrich. The health status decline of the field protective forest belts developed with high intensity on large areas. The forest belts of *Fraxinus* spp. and *U. minor* were in the worst health status.

During the period 2020–2023, strong damage caused by singing cicadas (Hemiptera: Cicadidae) was registered on ash trees (*Fraxinus* spp.) in the field protective forest belts in northeastern Bulgaria (Georgieva et al., 2024a). The endophytic fungus

Biscogniauxia mediterranea (De Notaris) Kuntze (Xylariaceae, Ascomycota), a causal agent of charcoal canker disease, was established for the first time on red oak (*Q. rubra*) in Bulgaria in the field-protective forest belts planted in the SHE Balchik and SFE Dobrich (Georgieva et al., 2024b). Rapidly progressing decline of trees were observed, resulting in death.

The aim of the present study was to examine the main biotic factors responsible for health status deterioration of major tree species planted in the field-protective forest belts planted in the northeast of Bulgaria.

Objects and Methods

In the period May-October (2023), the health status of major tree species planted in a system of field-protective forest belts at the territory of SHE Balchik, and SFEs General Toshevo and Dobrich was assessed (Fig. 1).

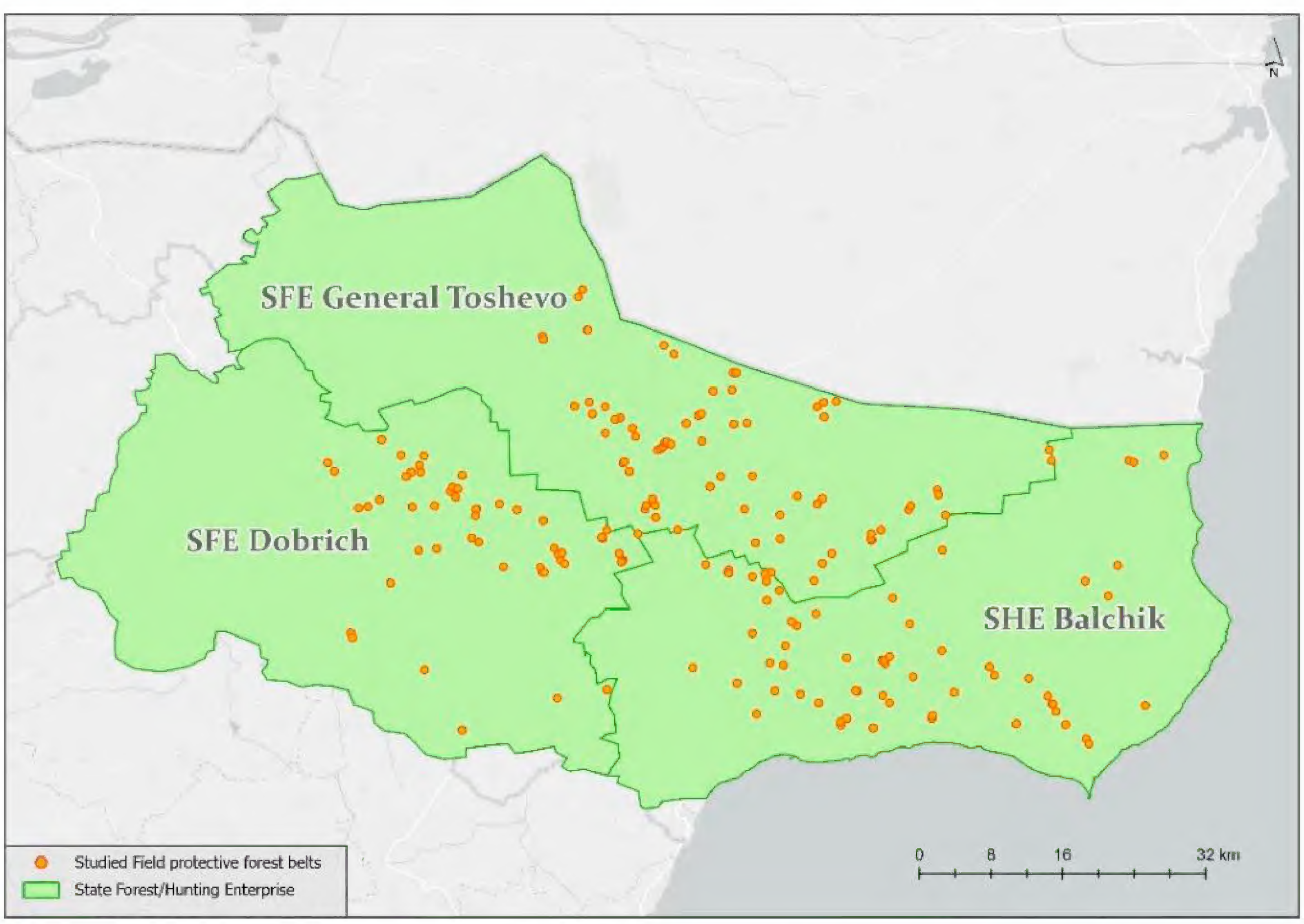

Figure 1. A map of studied field-protective forest belts in State Hunting/Forests Enterprises

The health status of 190 field protective forest belts was evaluated (67 in SHE Balchik, 70 – in SFE General Toshevo and 53 – in SFE Dobrich), with a total number of 8360 assessed trees (Table 1).

The health status assessment of trees included: categorisation of field-protective forest belts by the degree of damage; establishing the main factors for tree deteriora-

Table 1. Assessed major tree species in the field protective forest belts at the territory of SHE Balchik, SFE General Toshevo and SFE Dobrich

Studied tree species	Number of studied trees			Total	Percent
	SHE Balchik	SFE General Toshevo	SFE Dobrich		
Fraxinus excelsior L.	1280	1120	960	3360	40.2
Quercus cerris L.	560	640	520	1720	20.6
Fraxinus americana L.	240	320	280	840	10.0
Gleditsia triacanthos L.	320	280	200	800	9.5
Robinia pseudoacacia L.	120	240	80	440	5.3
Ulmus minor Mill.	80	200	40	320	3.8
Quercus robur L.	40	80	40	160	1.8
Quercus frainetto Ten.	120	-	-	120	1.4
Fraxinus angustifolia Vahl	0	80	40	120	1.4
Quercus rubra L.	40	40	40	120	1.4
Aesculus hyppocastanum L.	80	-	-	80	1.0
Cedrus atlantica (Endl.) Batt. & Trab.	80	-	-	80	1.0
Juglans regia L.	40	40	-	80	1.0
Acer pseudoplatanus L.	40	-	-	40	0.5
Fraxinus ornus L.	40	-	-	40	0.5
Tilia platyphyllos Scop.	40	-	-	40	0.5
Total	3120 (37.3%)	3040 (36.3%)	2200 (26.4%)	8360	100

tion; clarifying the complexes of insect pests and fungal pathogens according to the main tree species.

Defoliation assessments of trees were undertaken using classes of 5%, in comparison to a healthy referent tree, following ICP Forests manual (Eichhorn et al., 2020). Degree of damage was classified according to five categories: fully foliated (0–10% defoliation), slightly defoliated (>10–25%), moderately defoliated (>25–60%), severely defoliated (>60–99%) and dead trees (100%).

The effect of the damaging agent on individual trees was assessed according to their vulnerability. The following indicators were evaluated: health condition of the crown (top and degree of decline the main branches); an extent of the crown damaged by phytophagy insects; the condition of the trunk and the presence of frost cracks, traces of lightning, stripped of bark, hollows, cancers and lesions, fruiting bodies etc.; the tree settlement by great capricorn beetle and other insects-xylophagy.

The identification of insect pests and fungal pathogens was carried out in the laboratories of the Forest Research Institute in Sofia, equipped with a stereo microscope Leica MS5, complete with digital camera Leica DFC 295, Zeiss NU2 microscope, Optika B1000, equipped with an Optika C-P8 camera.

Results

The health status of a total of 15 tree species from 10 genera was assessed (Table 1). The share of species from genus *Fraxinus* was highest – 52.1%, as they were the most frequently planted tree species in the field-protective forest belts in northeastern Bulgaria. *Quercus cerris* (20.6%) and *G. triacanthos* (10%) forest belts ranked second and third in abundance, respectively (Table 1). The number of the assessed tree species with low proportion varied between 0.5% (*A. pseudoplatanus*, *F. ornus* and *T. platyphyllos*) and 5.3% (*R. pseudoacacia*).

During consecutive years, the severity of the defoliation was patchy at the regional scales and the individual tree species. Since 2020, distinct increase in defoliation in *F. excelsior* and *U. minor* trees has been established in SHE Balchik. In 2023, the proportion of fully defoliated trees increased significantly in both species. Almost 50% of *F. excelsior* trees were highly damaged with defoliation 70-100%. All *U. minor* trees were severely damaged, and 63.8% of them were totally dead (Fig. 2).

In the area of SHE Balchik, deterioration in health status and dieback of trees was observed in belts with *Q. frainetto* (13.7% dead trees), *Cedrus atlantica* (7.5%), *F. americana* (5.8%), *Q. rubra* (5%), *R. pseudoacacia* (4.2%) (Fig. 2). Slight defoliation was evaluated on *A. pseudoplatanus*, *A. hyppocastanum*, *T. platyphyllos* and *F. ornus* forest belts, where a great number of trees (87.5-100%) were without the visible signs of this process.

Deterioration of the health status, with a share of dead trees between 17.1% (*F. excelsior*) and 82.5% (*Q. rubra*), was registered in SFE Dobrich (Fig. 3). Most trees

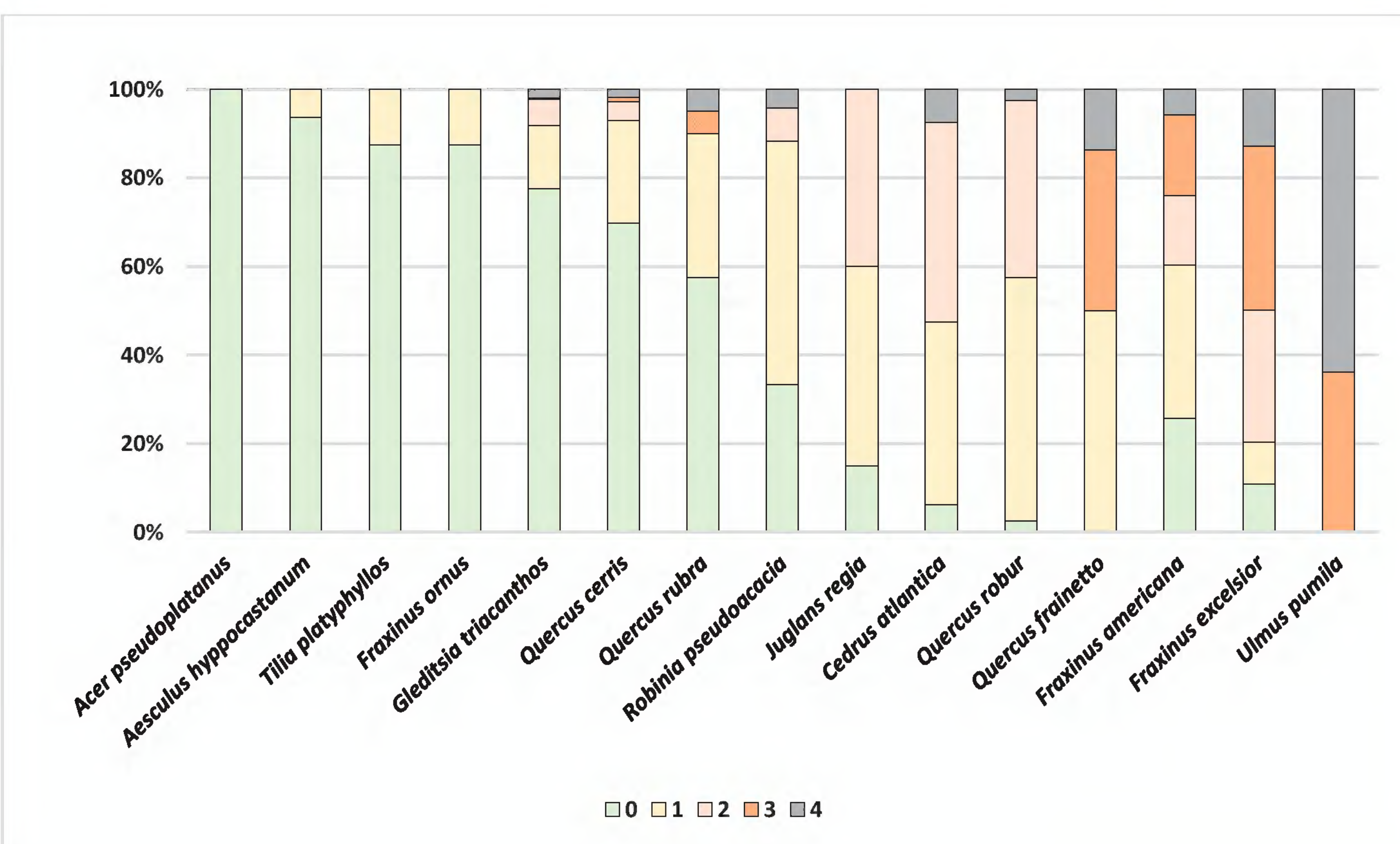

Figure 2. Degree of damage the field protective forest belts on trees in SHE Balchik

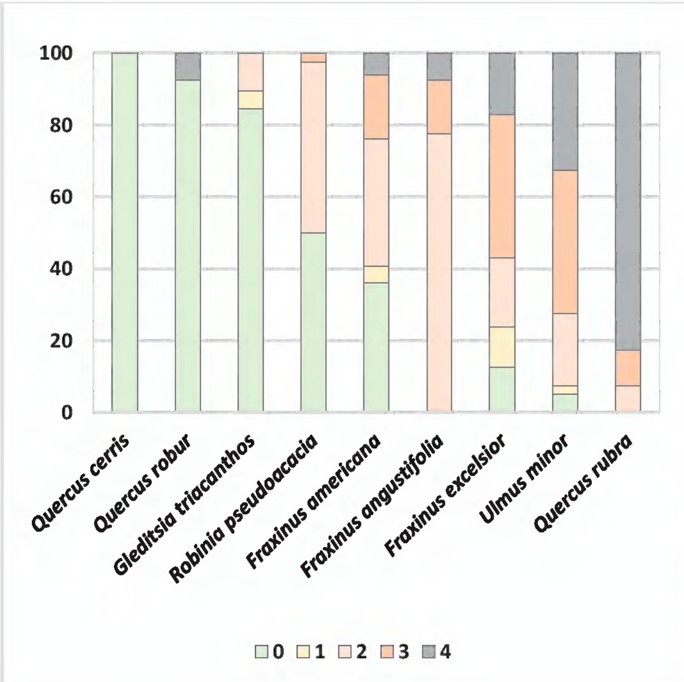

Figure 3. Degree of damage on trees in the field protective forest belts in SFE Dobrich

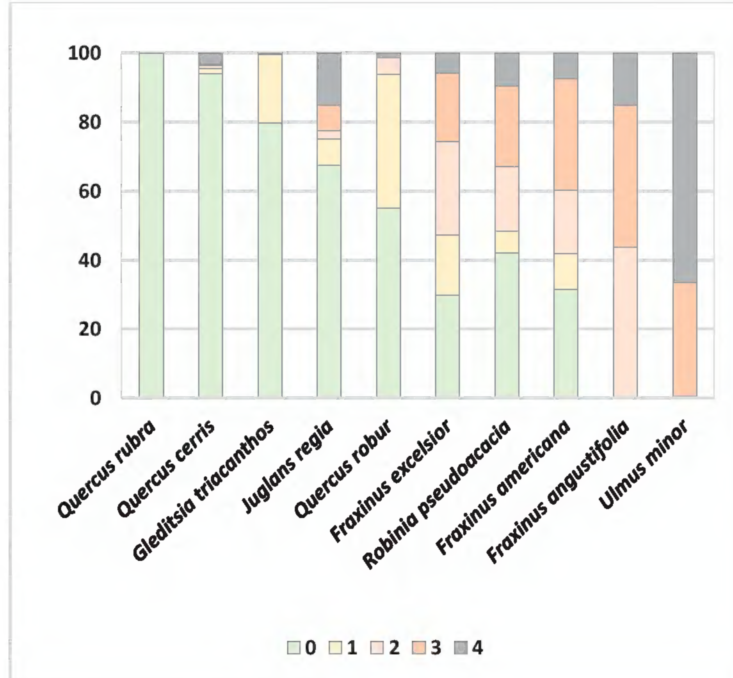

Figure 4. Degree of damage on trees in the field protective forest belts in SFE General Toshevo

of *Q. cerris* (100%), *G. triacanthos* (94.5%) and *Q. robur* (92.5%) experienced none to slight defoliation. The rate of moderately to severely defoliated trees was assessed between 50.0% in the field-protective forest belts of *R. pseudoacacia* and 85.0% in *F. angustifolia*.

In SFE General Toshevo crown defoliation rates were the highest in the forest belts with *U. minor*, *Fraxinus* species and *R. pseudoacacia* (the percentage of severely defoliated and dead trees trees was between 25.0% for *F. excelsior* and 100% for *U. minor*) (Fig. 4). None to slightly defoliated trees (with defoliation < 25%) were evaluated in *Q. rubra* and *G. triacanthos*. Oak species showed similar low defoliation levels of crown defoliation.

Mean defoliation for individual tree species varied across the three State Enterprises, but higher values were reported for *U. minor* (88.0%), *F. angustifolia* (72.5%), *F. excelsior* (53.9%), *Q. rubra* (55.3%), *Q. frainetto* (53.4%) and *F. americana* (50.5%) (Fig. 5).

Crown defoliation showed two distinct behaviours for tree species (Fig. 5). The distribution of highly defoliated trees (with defoliation >60%) in *U. minor, Fraxinus* species, *Q. rubra* showed a progressive increase in defoliation. Mean crown defoliation >30.0% was evaluated at 60.0% of the assessed tree species. Extreme defoliation and tree mortality occurred in 2023 after years with severe summer drought. Such conditions stressed trees and led to decline. Insect pest and fungal pathogens attacked trees and caused damage to leaves, branches, stems and roots. Some of the common pests and diseases that affected trees included: insects such as aphids, bark beetles, wood-boring beetles, scales; fungal diseases such as powdery mildew, necrosis, canker and root rot. Insects (especially defoliators) were the most frequently reported

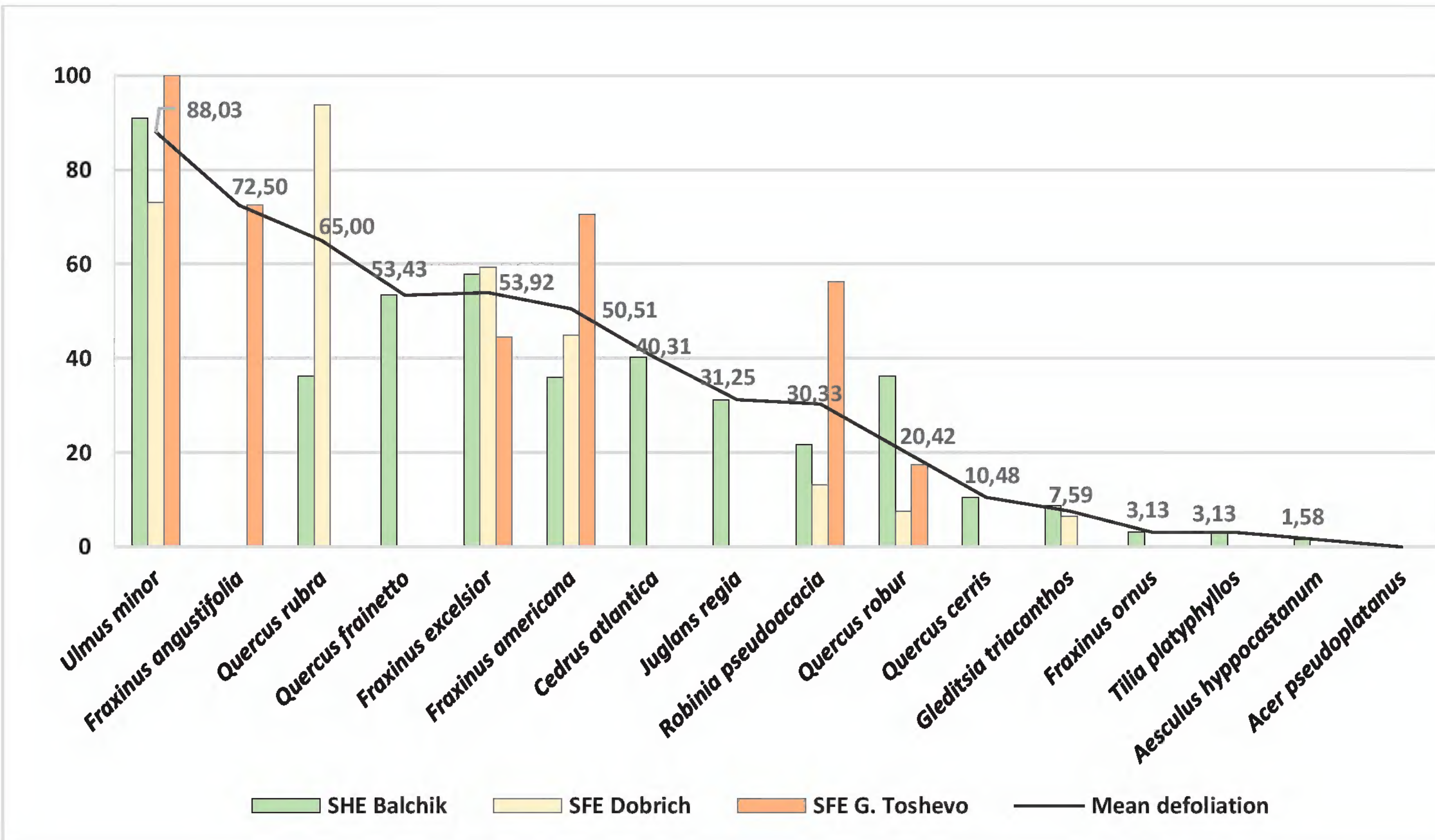

Figure 5. Mean crown defoliation of trees assessed in the field-protective forest belts in the SHE Balchik, SFE General Toshevo and SFE Dobrich

biotic factor causing tree damage, while drought was the main abiotic factor reported. Many pests and diseases in environmental stresses contributed to the decline of ash trees (Table 2).

Mass drying of *Ulmus minor* trees (Fig. 6A) resulted from the development of the tracheomycosis disease, caused by *Ophiostoma novo-ulmi*. The main vector of the disease was the bark beetle *Scolytus scolytus* (Fabricius, 1775) (Fig. 6B). Crown dieback in *Fraxinus* spp. trees (Fig. 6C) occurred due to the damage from the oviposition of *Cicada orni* and other singing cicadas on the young shoots and petioles (Fig. 6D), and the drying of *Quercus rubra* (Fig. 6E) occurred due to the infection of the trunk and crown by the oak charcoal disease, caused by *Biscogniauxia mediterranea* (Fig. 6F).

Many exuvia of the *Cicada orni* were found on the stems and branches of ash trees. On the upper shoots and petioles, numerous oviposition holes were observed, which lead to leaf fall and drying of branch tips. In different belts, tree crown damage ranged from a moderate (25-60% defoliation) to a severe (>60% defoliation) degree. The attacks were stronger on *F. excelsior* and *F. americana* compared to *F. angustifolia*. The cicadas affect both old trees and young ash saplings. In young plantations, other tree species (*Sophora japonica*, *Gleditsia triacanthos*) were also affected. Imaginal activity of *Cicada orni* was recorded in July and August, and the peak of egg hatching occurred from early August to mid-September.

Insect pest species were found in the field-protective forest belts. However, those of them that caused deterioration damaged non-renewable and hard-to-renew tissues

Table 2. Species composition and harmfulness of insect pests and fungal pathogens in the field protective forest belts in the SHE Balchik, SFE General Toshevo and SFE Dobrich

Family, species	Plant host	Damaged parts of plants	Harm-fulness*
Insect pests			
Acrobasis consociella ((Hübner)	*Quercus cerris*; *Quercus robur*	leaves	*
Archips sp.	*Quercus cerris*	leaves	*
Cameraria ohridela Deschka & Dimić	*Aesculus hippocastanum*	leaves	**
Cicada orni Linnaeus	*Fraxinus* spp.	petioles, shoots	***
Cossus cossus (Linnaeus)	*Fraxinus* spp.	stems	**
Corythucha arcuata (Say)	*Quercus cerris*	leaves	**
Dasineura acrophila (Winnertz)	*Fraxinus* spp.	leaves	*
Dasineura fraxini (Bremi)	*Fraxinus* spp.	leaves	*
Hylesinus fraxini (Panzer)	*Fraxinus* spp.	stems	***
Hylesinus crenatus (Fabricius)	*Fraxinus* spp.	stems	***
Kermes roboris (Fourcroy)	Quercus rubra	shoots	**
Lymantria dispar (Linnaeus)	*Quercus cerris*	leaves	***
Phylonorichter quercifoliella (Zeller)	*Quercus cerris*; *Quercus robur*	leaves	*
Prociphilus fraxini (Fabricius)	*Fraxinus excelsior*	leaves	*
Scolytus scolytus (Fabricius)	*Ulmus minor*	stems	***
Zeuzera pyrina (Linnaeus)	*Fraxinus excelsior*	stems	***
Fungal pathogens			
Apiognomonia quercina (Kleb.) Höhn	*Quercus* spp.	leaves, acorns	*
Armillaria mellea (Vahl) Kumm.	*Fraxinus* spp., *Quercus* spp.	roots, stems	***
Auricularia auricula-judae (Bull.) Quél.	*Fraxinus* spp.	saprotroph	*
Biscogniauxia mediterranea (De Notaris) Kuntze	*Quercus rubra*	stems	***
Ceratocystis roboris (Georg. et Teod.)	*Quercus robur*	stems	***
Cryptostroma corticale (Ellis & Everhart) Gregory & Waller	*Acer pseudoplatanus*	stems	***
Cytospora pulchella (Sacc.)	*Fraxinus* spp.	branches, stems	*
Cytospora sp.	*Gleditsia triacanthos*	stems	*
Daldinia concentrica (Bolton: Fr.) Ces.	*Fraxinus* spp.	saprotroph	*
Diplodia sp.	*Fraxinus* spp.	leaves, petioles	**
Erysiphe alphitoides (Griffon & Maublanc) Braun & Takamatsu	*Quercus cerris, Quercus robur*	leaves	*
Helicobasidium purpureum (Tul.) Pat.	*Fraxinus* spp.	stems	*
Hysterographium fraxini (Pers.) de Not	*Fraxinus* spp.	stems	**
Phaeoporus nidus-pici (Pilát) Spirin	*Quercus cerris*	stems	**
Nectria sp.	*Quercus robur*	stems, bark	**
Ophiostoma novo-ulmi (Buism.) Melin & Nannf.	*Ulmus minor*	stems	***
Pezicula cinanamomea (DC.: Fr.) Sacc.	*Quercus robur*	stems	**
Phellinus igniarius (L.) Quél.	*Fraxinus* spp.	stems	**
Phomopsis sp.	*Fraxinus* spp.	stems	**
Phyllosticta paviae Desmazières	*Aesculus hippocastanum*	leaves	*
Schizophyllum commune Fr.	*Quercus rubra*, *Tilia platyphyllus*	saprotroph	*
Stereum hirsutum (Willd.) Pers.	*Quercus rubra*	stems	*

***Harmfulness:** *does not manifest itself as a pest (saprotroph); **slight damage; ***severe damage (destructive pest)

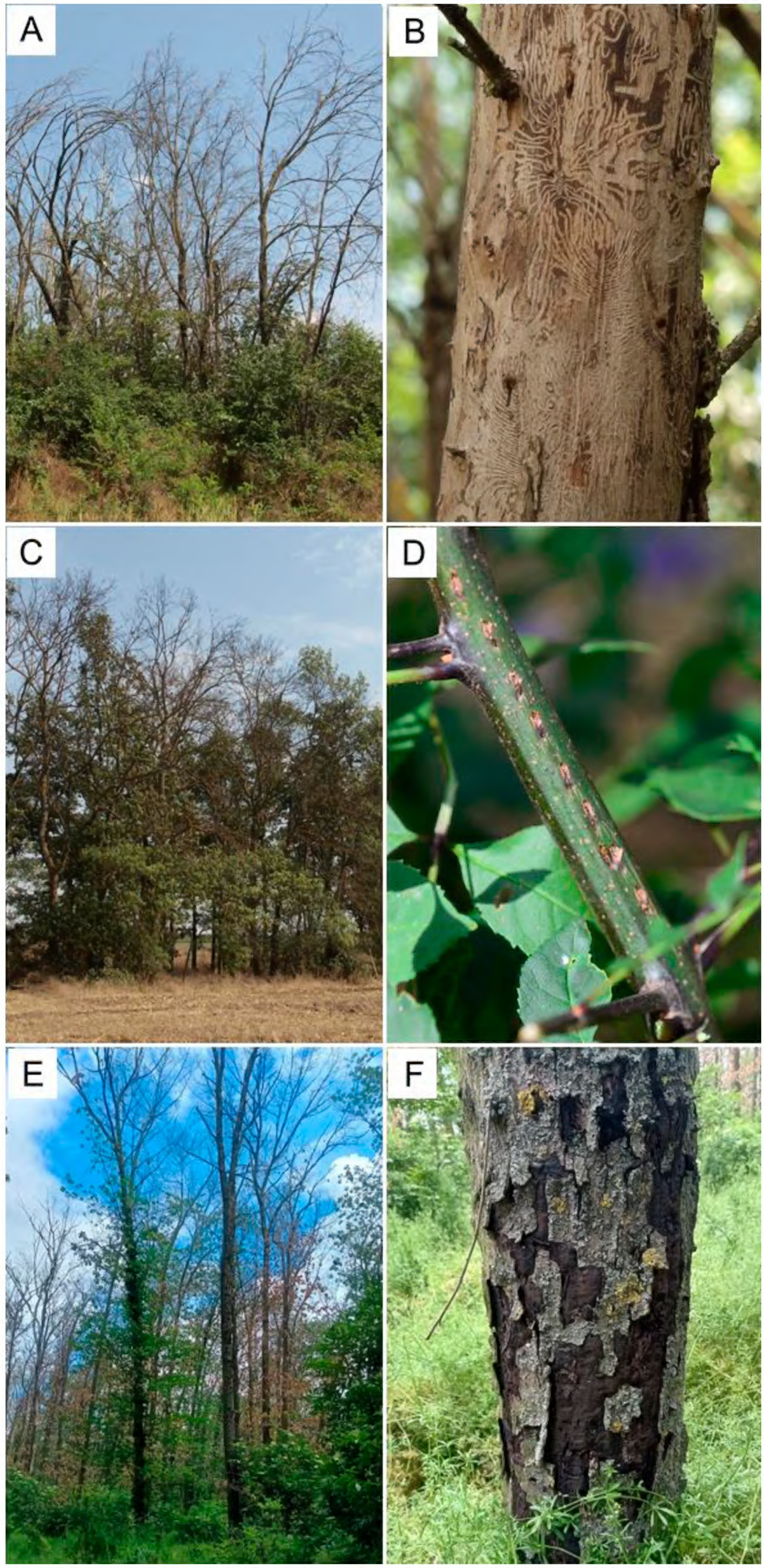

Figure. 6. Drying of field protective forest belts: A – dried trees of *Ulmus minor*; B – damage by *Scolytus scolytus*; C – drying trees of *Fraxinus excelsior*; D – damage from singing cicadas; E – dried trees of *Quercus rubra*; F – stroma of *Biscogniauxia mediterranea*

and organs (bark, phloem and sapwood) *Scolytus scolytus* (Coleoptera: Buprestidae) on *U. minor*, *Cicada orni* Linnaeus, 1758 (Hemiptera: Cicadinae), *Hylesinus fraxini* (Panzer, 1779), *Hylesinus crenatus* (Fabricius, 1787) (Coleoptera: Curculionidae, Scolytinae), *Zeuzera pyrina* (Linnaeus, 1761), *Cossus cossus* (Linnaeus, 1758) (Lepidoptera: Cossidae) on *Fraxinus* spp., etc.

An insect pest which attacks oaks, the oak lace bug, *Corythucha arcuata* Say, 1832 (Hemiptera: Tingidae), was found on the leaves of *Quercus cerris* and *Q. petraea* trees. The entomopatogenic fungus *Entomophaga maimaiga* was introduced in SHE Balchik to prevent outbreaks and maintain gypsy moth (*L. dispar*) populations at low densities.

Fungal pathogens *Armillaria mellea*, *Cytophoma pulchella* (Sacc.) Gutne, *Cytospora* sp., *Daldinia concentrica* (Bolton: Fr.) Ces., *Endoxylina astroideae* (Fr. ex Fr.) Romell, *Helicobasidium purpureum* (Tul.) Pat., *Hysterographium fraxini* (Pers.) de Not, *Phomopsis* sp. were identified.

Damage caused by the endophytic pathogen *Biscogniauxia mediterranea* on *Quercus rubra* protective forest belts on the territory of SHE Balchik (Trigortsi village) and SFE Dobrich (Kozloduitsi village) is new for the host in Europe. Defoliation of trees in the two belts varies between 70-100%. Symptoms on infected stems included longitudinal bark cracks, peeling bark and drying of the crowns. The damage was expressed in the death of trees and branches.

Among tree species, *U. minor* was the most defoliated species, with the highest mortality rates (66.5-82.5%). High defoliation and mortality rates on *U. minor* were connected to the fungal pathogens affecting this species, including the attack of *Ophiostoma novo-ulmi*. Extensive tree dieback was a common symptom. Decay fungi were found on the trunk, branches or at the base of the dead tree.

Discussion

Tree decline is characterised by a progressive deterioration due to loss of vigor and health (Douglas, 2005.). Trees can decline for many reasons, and although one factor may be responsible, in most cases decline results from several factors, which are often both biotic and abiotic. Ash (*Fraxinus* spp.) trees planted in landscapes or field-protective forest belts in northeastern Bulgaria are located in relatively hot, dry sites and given little or no supplemental water. In 2023, deterioration of health status was documented in a total of 108 field-protective forest belts with *Fraxinus excelsior, F. americana* and *F. angustifolia*. The damage has been widespread since 2020, leading to severe crown defoliation and, in most cases, death in infected trees. General symptoms of decline included wilting, leaf scorch, sparse foliage, stunted twig growth, early leaves fall, dying branches, epicormic shoots, etc. The prolonged dry period (2020-2023) has increased the susceptibility of ash trees to insect pest attacks and disease development.

Damage caused by singing cicadas was most likely due to the weakening of ash trees with increasing age. Important bioecological regularities in the numerical dis-

tribution of some insect pests have been revealed and measures to control the most important of them have been proposed. During the period 2020-2023, strong damage caused by singing cicadas (Hemiptera: Cicadidae) was registered on ash trees (*Fraxinus* spp.) in the field protective forest belts (FPFBs) in South Dobrudzha, northeastern Bulgaria (Georgieva et al., 2024). Bioacoustic studies have shown that the sounds are of *Cicada orni*. The high number of *C. orni* necessitates the development of measures to control the pest in the FPFBs.

It is possible that the damage is indirectly related to climate change because cicada diversity is highly susceptible to climate warming. The uneven distribution of precipitation leads to the appearance of a humidity deficit, physiological weakening and drying of the attacked trees. The high number of the pests necessitates the development of measures to control them, because they are a threat not only to the adult trees, but also to the young saplings during the reconstruction of the field protective forest belts.

The fungus *Hymenoscyphus fraxineus*, also known as *Chalara fraxinea*, a name designating its asexual stage, is primarily responsible for the invasive disease, causing crown dieback, and this fungus is potentially subject to expansion in the European temperate oceanic ecological zones (Janse 1981; San-Miguel-Ayanz et al., 2016). The pathogen was not found in our study. In many European countries *H. fraxineus* has since caused the death of over 90% of all ash trees (Bakys et al., 2009; Skovsgaard et al., 2010).

Water stress during the last growing seasons seems to reduce red oak tree resistance and predispose them to be infected with the pathogen *Biscogniauxia mediterranea*. The disease has caused dieback of infected trees and increased their vulnerability to attacks by xylophagous insect pests (Georgieva et al., 2024). The sudden contrasting changes in weather conditions, including insufficient and excessively heavy rainfalls and extreme temperature values, create conditions for the transition of *B. mediterranea* into a parasitic phase (Bencheva, Doychev, 2022).

Dutch elm disease is considered one of the most significant tree diseases known in the world, having devastated the elm populations throughout Europe and North America (Brasier, 1991). The disease is very aggressive and is transmitted by the bark beetles of the *Scolytus* genus or throughout root connections, attacking principally mature *U. minor* leading to death in 2-3 years (Mittempergher, Santini, 2004).

Biological control of gypsy moth (*Lymantria dispar*) was carried out in 2021 in the field protective forest belts at the territory of the SHE Balchik by introducing the entomopathogenic fungus *Entomophaga maimaiga* (Entomophthorales: Entomophthoraceae). In the same year a mortality rate of 26.1% of the pest population was registered. In 2022 *E. maimaiga* and multiple nuclear polyhedrosis viruses of *Lymanria dispar* (*Ld*MNPV) caused a population collapse of the pest in the region (Georgiev et al., 2023).

It should be noted that the beginning of this activity was successfully initiated with the introduction of the entomopathogenic fungus *Entomophaga maimaiga* to control *Lymantria dispar* attacs in the forest belts in the Balchik region in 2021 (Georgiev et al., 2023). In the year of introduction, the mortality of the pest from the pathogen

was about 25%, but in 2022, the climatic conditions were more favorable, as a result of which the calamity of the fungus was completely suppressed. On this basis, an integrated system to combat the fungus was developed and proposed, with *E. maimaiga* having a key place in it, taking into account the gradation phase of the fungus, the population density of the pest and the specific geographical and climatic conditions.

An insect pest which attacks oaks, the oak lace bug (*Corythucha arcuata*) can reduce growth and weaken trees. With a number of other diseases already affecting oaks, the arrival of the oak lace bug would pose a serious threat. Spots of colour loss (chlorosis) on the upper surface of the leaves appear as the pest feeds on sap within the oak. Spots of chlorosis join together into large yellow and bronze patches as populations increase. Leaf drop can occur with heavy infestations. Droplets of liquid frass (waste material) deposited by the bug on the undersides of the leaves as it feeds. These dry into hard black spots. Consecutive years of severe oak lace bug damage, combined with other stress factors, might even kill some trees. Any damage will be most severe during dry weather, when trees are already under stress.

Conclusions

In recent years, intense drying of the field-protective forest belts in northeastern Bulgaria has been registered as a result of physiological weakening of tree vegetation and deterioration of ecological conditions (reduction in the amount and uneven distribution of precipitation, presence of prolonged periods of drought, heat waves, etc.). Undoubtedly, the drying processes will deepen as the age of tree and shrub vegetation increases and the harmful effects of aggressive insect pests and fungal pathogens appear. For this reason, it is necessary to develop and implement a system for monitoring and assessing the health status of the field protective forest belts as an objective basis for making management decisions.

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